ology in Belgium by J. Vincent, meteorologist at the observatory, which contains exhaustive references to the literature of the subject, beginning in fact with Charlemagne, who promulgated and established the use of twelve compass points instead of the sixteen now used in the notation of the winds, viz, east, east by south, south by east, south, south by west, west by south, west, west by north, north by west, north, north by east, east by north, all which were sometimes known as the twelve apostles.

The most ancient name that can actually be cited in meteorological matters is Thomas of Cantimpré, who was born in Brabant in the early part of the thirteenth century and was the author of the work Die Naturis Rerum, which was finished about 1250 and often attributed to Albert the Great. The history of modern scientific meteorology in Belgium begins with Simon Stévin, born at Brussels in 1548 and died in Holland in 1620. His ideas as to gravity, hydrostatics, the fall of heavy bodies, the weight of the air seem to have been quite correct. He first gave two methods for determining the elevations of the clouds. In one method, assuming that the cloud is isolated in the sky and almost stationary, he measures the angular altitude of the cloud and takes a corresponding measure of the location of its shadow on the ground. In the second method he makes two measures of the angular altitude, from the extremities of a base line, the cloud being near the zenith. His ideas on geology and other branches of science were generally clear and correct. In Girard's translation of the works of Stévin he interpolates ideas of his own, such as the vesicular theory of cloud particles which was not at all known to Stévin. To another Belgian meteorologist, F. d' Aiguillon, born at Brussels in 1556, we owe the methods of projection known as orthographic, stereographic, and scenographic, as well as investigations into the optical phenomena of the atmosphere. Of later authors Fromondus (or Libert Froidmont), Fienus (or Feyenes), Vendelinus (or Wendelin), F. Linus (or F. Hall), Sluse (or R. F. Walter), L. Gobart, F. Verbiest, J. A. Brown, (born in 1702, died in 1768) are especially mentioned.

A chapter is devoted to the earthquakes observed in Belgium, of which the earliest occurred in the year 330, and the next in 502, but of course only prominent, destructive quakes are mentioned in the early records. At the present time every tremor is recorded by self-registering apparatus and the periodicities, both diurnal and annual, seem to be present.

After a section devoted to fundamental meteorological data and tables of reduction, the Annuaire gives an elaborate account of two ancient meteorological journals, one relating to the period 1778–1810, the other to the period 1807–1850. This is followed by an article on the climate of Ardenne, written at the request of the Belgian Department of Agriculture. These and several essays together make the Annuaire for 1901 an interesting contribution to meteorology.

OFFICIAL STANDARD TIME.

In the Astronomical Annual for 1901 of the Royal Observatory of Belgium, the director, Dr. L. Niesten, says that—

> In the astronomical annals we shall continue to make use of local meantime until that very desirable epoch when astronomers shall agree to substitute civil time for it.

Civil time begins at midnight, and should be counted onward for twenty-four hours; astronomical time begins at noon, and is counted onward for twenty-four hours.

Official time in Belgium is the civil time for the meridian of Greenwich. This is the legal time used by government officials, railroads, and post offices, and may be called public or popular time. The legal time in other countries is stated by Dr. Niesten, on page 159 of this Annuaire, to be as follows:

> Western European time, or the civil time of the Greenwich meridian, is legal in England, Belgium, Holland, and Luxemburg. In Belgium the 24-hour notation has been used since May, 1897, in the post office, telegraph, and telephone departments, as also by the railroads and the navy.
>
> Central European, or one hour east of Greenwich, is legal in Germany, Austria-Hungary, Bosnia, and Herzegovina, the Congo Free State, Denmark, Italy, Servia, Sweden, Norway, and Switzerland. In Italy the hours are counted from midnight on to twenty-four.
>
> The meridian of one hour thirty minutes east of Greenwich is adopted by the railroads and telegraphs in Cape Colony.
>
> Eastern European time, or the meridian of two hours east of Greenwich, is adopted by Bulgaria, Roumania, and Natal, and by the railroads of Turkey in Europe. The meridian of eight hours east of Greenwich is adopted by West Australia.
>
> The meridian of nine hours west of Greenwich is adopted by Central Australia and by Japan.
>
> The meridian of ten hours east has been adopted by Victoria, Queensland, and Tasmania.
>
> The meridian of eleven and a half hours has been adopted by New Zealand.
>
> As is well known, Canada and the United States and Mexico have adopted as standard hours the fifth, sixth, seventh, and eighth west of Greenwich. In Canada the notation from zero to twenty-four continuously has also been authorized.
>
> The 24-hour notation has also been introduced into the railroads of British India, where the fifth and sixth hours east of Greenwich are commonly used as standard meridians.
>
> The eighth hour east of Greenwich would be appropriate to the Philippines, but we do not know that the American authorities have issued any regulations bearing on this point.
>
> The Hawaiian Islands adopt the meridian of ten and a half hours west of Greenwich.
>
> The nations that have not adopted the Greenwich system are as follows:
>
> In Spain the legal hour is that of the meridian of Madrid, or 14*m* 45*s* west of Greenwich; in Spain the 24-hour enumeration has lately been adopted.
>
> Portugal adopts the time of the meridian of Lisbon, or 36*m* 39*s* west of Greenwich.
>
> Russia adopts the meridian of St. Petersburg uniformly for its whole domain, or 2h. 1m. 13s. east of Greenwich.

The above data may differ slightly from that published elsewhere. In fact, it is difficult to gather correct statistics for all parts of the world, and the Editor will be pleased to publish any corrections or additions to this list.

It is important to bear these standards in mind when one wishes to compare the exact time of occurrence of any event that is observed in two different countries. We recall vividly a remarkable discrepancy in the hourly temperature records kept in a certain hospital where the morning readings were made by a subordinate who happened to be a Frenchman, and the afternoon readings by one who happened to be a German. The thermometer was unfortunately graduated in the Centigrade system on one side and the Réaumur system on the other. As a matter of course, the morning records were kept in the former and the afternoon records by the latter system. Nothing was said about this in the published records, and it took the Editor a long time to ferret out the cause of the discrepancies. Doubtless, analogous discrepancies are introduced every day by the differences between sun time, local mean time, and legal standard time. In proportion as we progress toward one absolutely uniform standard of time, such as Greenwich, we shall eradicate discrepancies and increase the accuracy of all work in terrestrial physics.

THE WORK OF THE METEOROLOGICAL INSTITUTE OF PRUSSIA.

The Meteorological Institute of the Kingdom of Prussia, (K. Preussische Meteorologische Institut), directed by Dr. von Bezold, includes: (1) The Central Institut of Berlin, divided into four sections: (*a*) Climatology and miscellaneous; (*b*) atmospheric precipitation and library; (*c*) storms, accidental atmospheric phenomena and instruments; (*d*) aeronautics;

(2) Observatory of Potsdam of which Dr. Sprung is director, including two sections; (*a*) meteorology and terrestrial magnetism; (3) 202 stations, of which 148 are in Prussia (123 first and second order, 71 third, and 8 fourth order).

In the course of the year 1899 the number of rainfall stations was increased by 70. January 1, 1900, it was raised to 2,315, including the 202 meteorological stations just mentioned. The study of atmospheric precipitation is of great practical importance; it interests agriculture as well as industry; now that the rivers have again become very important mediums of transportation and that they are the sources of energy, it is of the utmost importance to be acquainted with their regimen and their sources of supply.

In this same train of thought the Meteorological Institute of Prussia carried on in December, 1899, observations of the depth of snow on the ground and its equivalent in water, and established a service of forecasts bearing on this subject. Thus, December 19, it was able to send to the hydrographic services of the five great rivers of Germany dispatches indicating the depth of the snow in the five basins, observed the day before at 7 a.m. The geographers and the meteorologists can refer for details to the weekly reports as to the depth of snow on ground in north Germany.

The annual report of the Royal Meteorological Institute of Prussia contains the list of the publications issued either by this scientific establishment or by its colaborers.

TEMPERATURE OF DEEP LAKES.

In the MONTHLY WEATHER REVIEW for 1898, page 167, we have mentioned the thermophone devised by H. C. Warren and G. C. Whipple, and first described by them in the Technology Quarterly, 1895, Vol. VIII, pages 25–152. A previous elaborate paper by Prof. W. R. Nichols was read in 1880 before the Boston Society of Natural History. Observations relating to Clear Lake, N. B., were made by Prof. W. F. Ganong of Smith College, Northampton, Mass., but those made by the inventors and Mr. Desmond Fitzgerald in Lake Cochituate were more elaborate and established the great value of this apparatus. Previous to that time the deep sea thermometers of Negretti and Zambra or Casella were the best available. H. B. de Saussure used in Switzerland an ordinary thermometer so protected that it could be hauled up a thousand feet without changing its temperature 1° centigrade. A series of observations by the older methods had been carried on for five years by Mr. Fitzgerald before the thermophone became available; the results of both series mutually confirm each other. A similar series was observed at Lake Winnepesaukee and several other lakes or reservoirs and the general results of both American and European observations are given in the paper by Fitzgerald published in the Transactions of the American Society of Civil Engineers, Vol. XXXIV, pages 67–114.

In general, Mr. Fitzgerald showed that there is an annual inversion of the vertical circulation in a fresh water pond, by reason of which when in winter time the lowest portions begin to cool below 39° Fahrenheit or 4° centigrade they rise because of their diminishing specific gravity and bring up the products of decaying vegetation.

In a shallow lake, such as the reservoir, this circulation produces an appreciable discoloration and contamination of the upper water at certain seasons; it is therefore a matter to be considered in connection with the supply of fresh drinking water for a city. On the other hand, the study of temperatures in very large natural lakes is a matter of scientific inquiry leading to important results in connection with the temperature of the air and the occurrence of fog, cloud, and rain, the melting of ice floes, to say nothing of the distribution of fish and marine plants; it may also have a bearing on other questions not yet fully appreciated. The most recent contribution to the subject is a study of the temperatures of Lake Ladoga, which is the largest and one of the deepest bodies of fresh water in Europe. The Editor would, however, suggest that possibly the lower portions of Lake Ladoga are salt water, just as in case of some lakes near Boston which apparently owe their origin to a glacial process similar to that which gave rise to Lake Ladoga. In the Paris Comptes Rendus for June, 1900, Lieut. Jules de Schokalsky of the Russian Navy, published a map of Lake Ladoga and the results of his own examination of its temperature for the years 1897–99. As similar investigations should undoubtedly be made on our great American lakes we reprint this article; evidently the thermophone will do the work more satisfactorily than the "upset thermometer."—ED.

ICE CAVES.

On a preceding page we print a short account of the ice cave at Flagstaff, Ariz. There are many well-known cases in which glacial ice has been covered by earth to such a depth that it has been preserved for thousands of years, and the caves or wells penetrating therein preserve a temperature of 32° throughout the year. These, however, represent a very different phenomenon from that reported by Mrs. Renoe. In the ice cave at Flagstaff we have probably nothing to do with glacial ice; the ice is evidently formed annually within the cave and on the surfaces of its crevices. The ground around the caves can not have a temperature below that of freezing. The air temperatures at Flagstaff during December, January, and February frequently fall below freezing, and this wave of cold will penetrate many feet into the earth by the middle of summer, but this of itself would only give a low temperature in the ice caves and would not suffice to explain the formation of such masses of ice. It merely shows why the water percolating slowly into the caves must be of a low temperature. If there be a gentle circulation of the air going on, there must be a corresponding evaporation of a portion of this water, which will, of course, reduce the temperature still lower. Now, the dryness of the air at Flagstaff is often such that the temperature of the wet bulb thermometer is below freezing, and if there be a gentle circulation of such air within the cave, then ice may be formed.

Again, the entrance to the Flagstaff cave is at the bottom of a general depression in the ground; it must, therefore, receive the very cold air that settles into such hollows during clear nights; this air is cooled by contact with the surface of the ground, which latter is cooled by radiation to the clear sky. Even during the warm summer months the nocturnal radiation at this altitude (about 7,000 feet) is sufficient to produce temperatures below freezing, so that the water percolating through the soil into the cave may be frozen by contact with the cold air within the cave if the latter is slowly renewed every night.

The formation of ice in the cave near Flagstaff is undoubtedly not an isolated case and similar examples should be sought for and brought to the attention of the readers of the MONTHLY WEATHER REVIEW. Those interested in the subject would do well to test our suggested explanation by making accurate observations of the temperature and moisture of the air close to the surface of the ground at the time of the morning minimum temperatures, and especially during the summer months.

The Ice Trade Journal has from time to time published accounts of similar ice caves in various parts of the world. The February number states that about twelve miles from Ehrenbreitstein and a short distance from the Wallmerod